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SITE SELECTION
FOR
GROUND BASED FREE ELECTRON LASER TECHNOLOGY INTEGRATION EXPERIMENT (GBFEL-TIE) (U)

VOLUME III
PREFERRED SITE EVALUATION

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U.S. ARMY STRATEGIC DEFENSE COMMAND

Prepared by

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ABSTRACT

This is Volume III in a series of site selection reports on the Ground Based Free Electron Laser - Technology Integration Experiment. Volume I, Site Selection Plan, described criteria used for initial site evaluations. Volume II, Initial Site Evaluation, documented the evaluation process that reduced the number of potential sites from 14 to 3. This third volume documents the selection of a preferred site from among those three locations.

This report explains the methodology used by the Site Selection Committee to establish a preferred site and summarizes the committee's findings.

It was established that the GBFEL-TIE could be accomplished at any of the three candidate sites. However, based on differences identified during site investigations and documented in this report, Orogrande was recommended as the preferred site.

Wildlife habitat disruption at the Stallion site, and impacts on desert bighorn sheep and archaeological resources at the North of NASA site were the major environmental factors. Estimated total costs for construction and operation of the GBFEL-TIE, including environmental mitigation costs, differed only slightly among the three sites, with the Orogrande site estimated to be the least expensive site. The history of seismic activity in the Socorro area indicated that siting the experiment at Stallion could cause a delay in gathering experimental data due to the necessity to periodically realign and calibrate optical equipment. Some program and schedule conflicts with current and future White Sands Missile Range programs were found to exist at all of the three sites. Substantially greater impacts, however, would occur at the Stallion site.

The final site decision was made by LTG James A. Abrahamson, Director, Strategic Defense Initiative Organization, after consideration of the public comments on the Army's recommendation as contained in the Final Environmental Impact Statement of the Proposed Ground Based Free Electron Laser-Technology Integration Experiment. The final site selection was documented in the GBFEL-TIE Record of Decision (See Appendix A).

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LIST OF ACRONYMS AND ABBREVIATIONS

BCS	Beam Control System
CD	Concept Definition
EIS	Environmental Impact Statement
EMI/EMC	Electromagnetic Interference/Electromagnetic Compatibility
FEL	Free Electron Laser
Ft. or ft.	Feet
GBFEL	Ground Based Free Electron Laser
GBL	Ground Based Laser
GBLPO	Ground Based Laser Project Office
HIDL	High Energy Laser Instrumentation Development Laboratory
K	One Thousand
Km	Kilometer
LANL	Los Alamos National Laboratory
LOS	Line Of Sight
M	Million
MIT/LL	Massachusetts Institute of Technology/ Lincoln Laboratories
NASA	National Aeronautics and Space Administration
NRAO	National Radio Astronomy Observatory
PHETS	Permanent High Explosive Test Site
PPM	Parts Per Million
R&D	Research and Development
RF	Radio Frequency
RFI	Radio Frequency Interference
ROW	Right Of Way
SDIO	Strategic Defense Initiative Organization
SSC	Site Selection Committee
SVC	Static Var Compensation
TIE	Technology Integration Experiment
USACE	U.S. Army Corps of Engineers
USASDC	U.S. Army Strategic Defense Command
WSMR	White Sands Missile Range

1.0 EXECUTIVE SUMMARY

1.1 BACKGROUND

Beginning in March 1986, the U.S. Army Strategic Defense Command (USASDC) conducted a siting analysis to identify the optimum location within White Sands Missile Range for the Ground Based Free Electron Laser-Technology Integration Experiment (GBFEL-TIE). As reported in Volumes I and II, the initial set of potential sites was screened and reduced to three sites, Stallion, North of NASA, and Orogrande, for further detailed investigations. This report summarizes the results of those detailed investigations, which covered 18 topics. One topic, environmental impact, is reported in detail in the Final Environmental Impact Statement of the Proposed Ground Based Free Electron Laser-Technology Integration Experiment, which is a complement to this report. The method by which the GBFEL-TIE Site Selection Committee (SSC) considered information on these topics and identified a preferred site is described in this volume.

The GBFEL-TIE SSC met from 29 September through 2 October, 1986, in Huntsville, Alabama to hear presentations by technical experts on the 18 site selection topics. The SSC evaluated the material presented, summarized the differences in the findings that would affect site selection, and established a relative ranking of the three sites under consideration. The candidate sites were compared in terms of differences in cost, schedule, research and test operations, and unavoidable environmental and mission conflict impacts. For example, topographic differences among sites were translated into construction cost differences. Where environmental impacts could be effectively mitigated, the cost and the time that would be required were estimated. The remaining, unavoidable impacts were also considered and expressed in terms of resource loss and/or risk. Investigative work continued following this October SSC meeting and some findings were revised as a result of additional analysis requested by the SSC. This additional activity did not alter the relative ranking of the sites. Later findings were coordinated informally and frequently with the SSC, culminating with a SSC review of all site data at White Sands Missile Range on December 10, 1986. Briefings by the SSC to appropriate levels of management occurred throughout the period November 1986 - March 1987.

1.2 CONCLUSIONS

A summary of major site selection factors is shown in Table 1-1. The 18 site selection topics (subfactors) were summarized in four major site selection factors. Table 1-2 explains the approach to site comparisons.

The results of the major site selection considerations are shown in Table 1-3. The total cost increase line is a summation of each sites' cost increments. The last line shows costs normalized to the site with the least total cost.

The environmental assessment favored Orogrande, with the other two sites having greater mitigation costs and greater unavoidable impacts to wildlife and to threatened and endangered species. Also, both North of NASA and Stallion had more risk of delay to the start of construction due to the time required to survey cultural resources at the sites and complete initial mitigation efforts. The high incremental cost cited for North of NASA was largely due to estimates for wildlife refuge replacement.

Construction/Engineering considerations favored Orogrande for Phase I and North of NASA for the total project. The most significant subfactor differences were due to long access roads at North of NASA and to the estimated interruptions to construction at the Stallion and Orogrande sites. Periodic site evacuations at Stallion or Orogrande were determined necessary due to on-going WSMR test operations. These interruptions would cause delays to the construction schedule and/or added cost to recover construction schedule delays. The cost of providing connections to the electrical power grid was also a cost-contributing item for the Stallion and North of NASA sites.

TABLE 1-1. SITE SELECTION SUMMARY

SELECTION FACTORS / DIMENSIONS	COST ($M)	DELAY IN CONSTRUCTION	TEST TIME LOST	UNAVOIDABLE IMPACT
Environmental Impact				
Construction/Engineering				
Experimental Issues				
Range Conflicts				

- All dimensions investigated for each factor and subfactors.
- All factors investigated for each site.

TABLE 1-2. APPROACH TO COMPARISON

- **Comparisons expressed in terms of additions to baseline**
- **Baseline is the lowest entry for each subfactor**
- **Entries are shown as:**

PHASE I / Total Project

- **Example (Cost Dimensions):**

SUBFACTOR / SITE	STALLION ($M)	NORTH OF NASA ($M)	OROGRANDE ($M)
ACCESS ROAD	0.0 / 0.0	6.9 / 6.9	0.2 / 0.2

- Stallion access road is lowest cost. Thus, it is shown as baseline (0.0) and the additional expense of similar access to other sites is shown.
- Other dimensions treated similarly

MAJOR SITE SELECTION CONSIDERATIONS

	STALLION			NORTH OF NASA			OROGRANDE		
	COST INCREASE ($M)	DELAY OR TEST TIME LOST	UNAVOIDABLE IMPACTS	COST INCREASE ($M)	DELAY OR TEST TIME LOST	UNAVOIDABLE IMPACTS	COST INCREASE ($M)	DELAY OR TEST TIME LOST	UNAVOIDABLE IMPACTS
Environmental Impact	0.6 / 1.1	Initial 2-3 mo.	Slightly greater wildlife and T&E risks	13.0 / 14.0	Initial 3-6 mo.	Greater wildlife, T&E and arch. impacts	0.0 / 0.0		
Construction Engineering	14.9 / 32.9			10.2 / 10.2			8.6 / 23.0		
Experimental	0.0 / 0.0	·8.0% avg. test time loss	Potential for additional delays	0.0 / 0.0			0.0 / 0.0		
Range Conflicts	0.0 / 0.0		Moderate	0.0 / 0.0		Some	0.0 / 0.0		Some
Total cost increase	15.5 / 34.0			23.2 / 24.2			8.6 / 23.0		
Marginal Differences	6.9 / 11.0	Initial 2-3 mo. & 8% test time loss	Slightly greater environ. & opns impacts; greater conflict	14.6 / 1.2	Initial 3-6 mo.	Greater, environ. impact	0 / 0		

TABLE 1-3 MAJOR SITE SELECTION CONSIDERATIONS

The only experimental consideration indicating significant site differences was seismic activity. The history of seismic activity in the Socorro area indicated that siting the experiment at Stallion could cause a delay in gathering experimental data due to the necessity to periodically realign and calibrate optical equipment.

Range conflict considerations favored both North of NASA and Orogrande over Stallion. At the Stallion site, program conflicts were found to affect all three military services and, in the opinion of WSMR personnel, would severely limit future operational capabilities of the National Range.

1.3 RECOMMENDATION

The SSC recommended Orogrande as the most suitable site because it would be the least costly, would experience the least delay in construction and in conduct of experiments, would create the least mission conflict and would have the least environmental impact. This recommendation was, in turn, made by the GBFEL-TIE Project Manager to the Commander, USASDC, and to the Director, SDIO.

2.0 SELECTION COMMITTEE PERSONNEL

The Ground Based Laser (GBL) Project Manager appointed a GBFEL-TIE Site Selection Committee (SSC) representing the relevant organizations and disciplines in March 1986. The SSC was tasked to recommend a preferred site to the GBL Project Manager.

The Committee membership was:

Chairman: LTC Frank J. Chapuran: Research and Development Coordinator for GBL Project Office, USASDC; Responsible for facilities planning and all site selection activities.

Mr. Lee A. Sulzberger: Geotechnical Engineer for U.S. Army Corps of Engineers, Huntsville Division; Twenty years experience in the design and construction of major projects.

Mr. James H. Harvey: General Engineer, Directed Energy Directorate at WSMR; Twenty-five years experience in design, construction, operation and maintenance of facilities.

Mr. B. L. Schmidt: General Engineer, Directorate for Installation Support at WSMR; Thirty years experience in engineering design, construction management, and facility operation and maintenance.

Mr. James T. Hall: Chief of Directed Energy and Instrumentation Branch, Atmospheric Sciences Laboratory, WSMR; Chairman of the DOD Group on High Energy Laser Meteorological Requirements, member of the DOD High Energy Laser Review Group (HELRG) propagation sub-panel, and author of many articles on environmental effects of laser propagation.

Technical Advisors to the committee were:

Electric Power/Utilities	Jim Moya GBL Project Office White Sands Missile Range, N.M. Electrical Engineer

Environmental Impact	Dr. Jim Mangi Teledyne Brown Engineering Huntsville, AL Environmental Scientist
Environmental Impact	Jim Ammons U.S. Army Corps of Engineers, Huntsville Division Huntsville, AL Chief of Environmental Section
Eye Safety	Rebecca Tracey General Research Corp. Huntsville, AL Scientist
Atmospheric Measurements	Dr. Kenneth White Atmospheric Sciences Laboratory White Sands Missile Range, N. M. Physicist
Atmospheric Measurements	John P. Kahler Optimetrics Las Cruces, N. M. Scientist
Construction/Engineering	Bobby Byrne U.S. Army Corps of Engineers, Fort Worth District, Ft. Worth, TX Engineer
Construction/Engineering	Shigeru Fujiwara U.S. Army Corps of Engineers, Fort Worth District, Ft. Worth, TX Chief of Construction Division
Cost Model	Jimmy Hudson U.S. Army Corps of Engineers, Huntsville Division, Huntsville, AL Chief Estimator
Facilities Risk Analysis	Wally Watanabe U.S. Army Corps of Engineers, Huntsville Division, Huntsville, AL Structural Engineer
Air Space Issues	John Hyndman GBL Project Office White Sands Missile Range, N. M. Engineer

Range Operations	Floyd Henderson Range Operations Division White Sands Missile Range, N. M. General Engineer
Range Operations	Jim Noble Range Operations Division White Sands Missile Range, N. M. General Engineer

3.0 MAJOR CONSIDERATIONS

3.1 CANDIDATE SITES

The GBFEL-TIE site evaluation process consisted of four phases: identification of potential sites, initial site evaluations, site validation studies and the final site recommendation. See Figure 3-1.

After an analysis of all WSMR real estate and application of specific exclusionary criteria, 14 candidate sites at WSMR were identified in April 1986 as potential locations for the GBFEL-TIE. The intent of the initial site evaluation phase was to narrow the original list of 14 candidate sites to a short list of sites. Through studies of existing data, on-site visits, and a limited series of atmospheric measurements, the initial site evaluation process was completed in May 1986 with the decision to proceed with validation studies at the most promising sites: Stallion, North of NASA and Orogrande. The three candidate sites are located as shown on Figure 3-2. The site validation phase consisted of extensive research, study and exploration in each of the topic areas listed in Figure 3-1. This activity proceeded in parallel and was coordinated with the preparation of an environmental impact statement (EIS). The findings of these investigations were then presented to the Site Selection Committee for their examination and deliberations leading to recommendation of a preferred site.

3.2 SITE EVALUATION METHODOLOGY

This section describes the approach used by the SSC to evaluate the three alternative sites and to identify the preferred site.

At the outset of this phase of study, it was anticipated that the three sites (Stallion, North of NASA, Orogrande) could differ from one another in many respects, such as seismic activity, foundation capabilities, and environmental impacts. A series of 18 studies (Figure 3-1) was carried out between May and October 1986 to

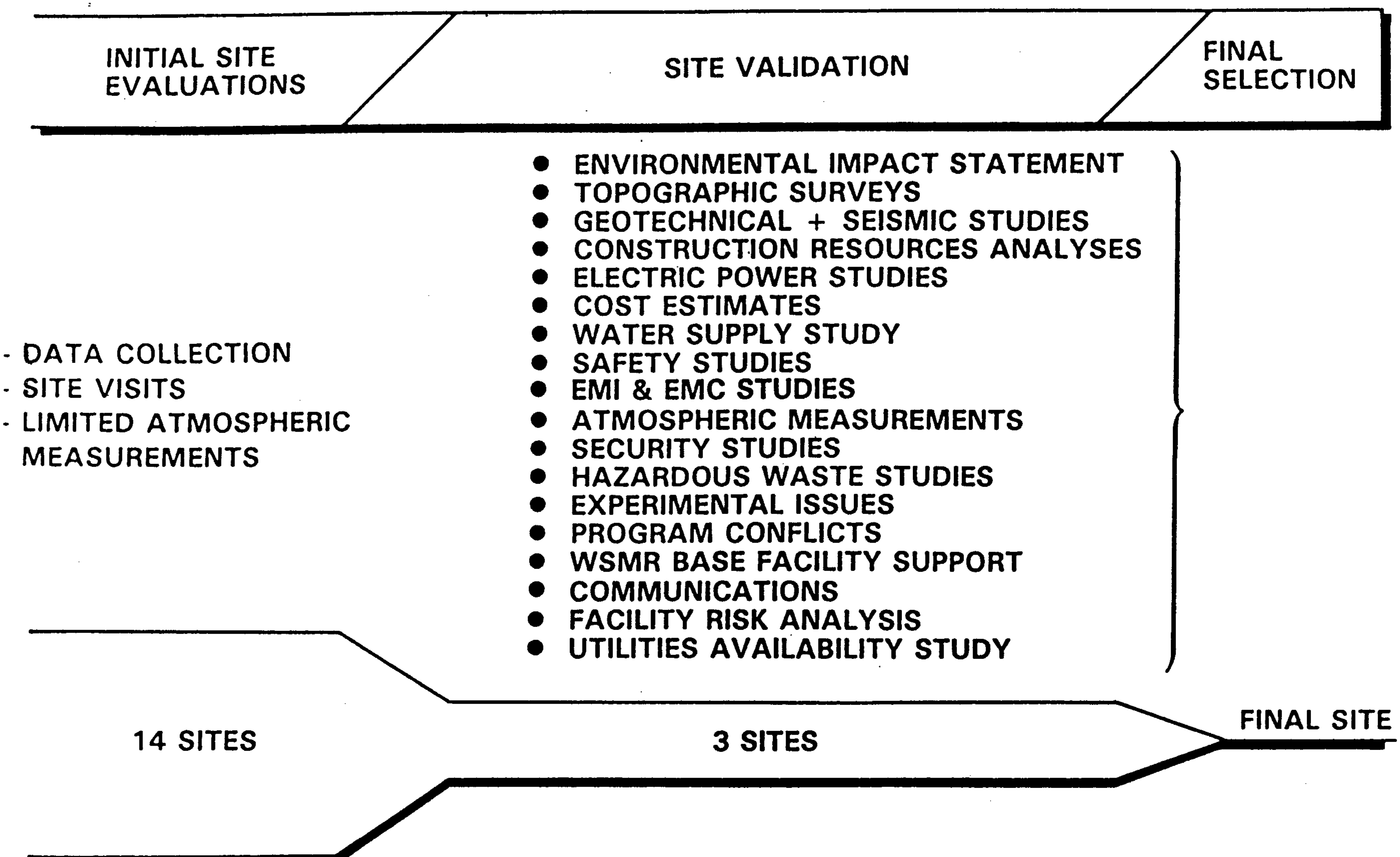

FIGURE 3-1 SITE EVALUATION

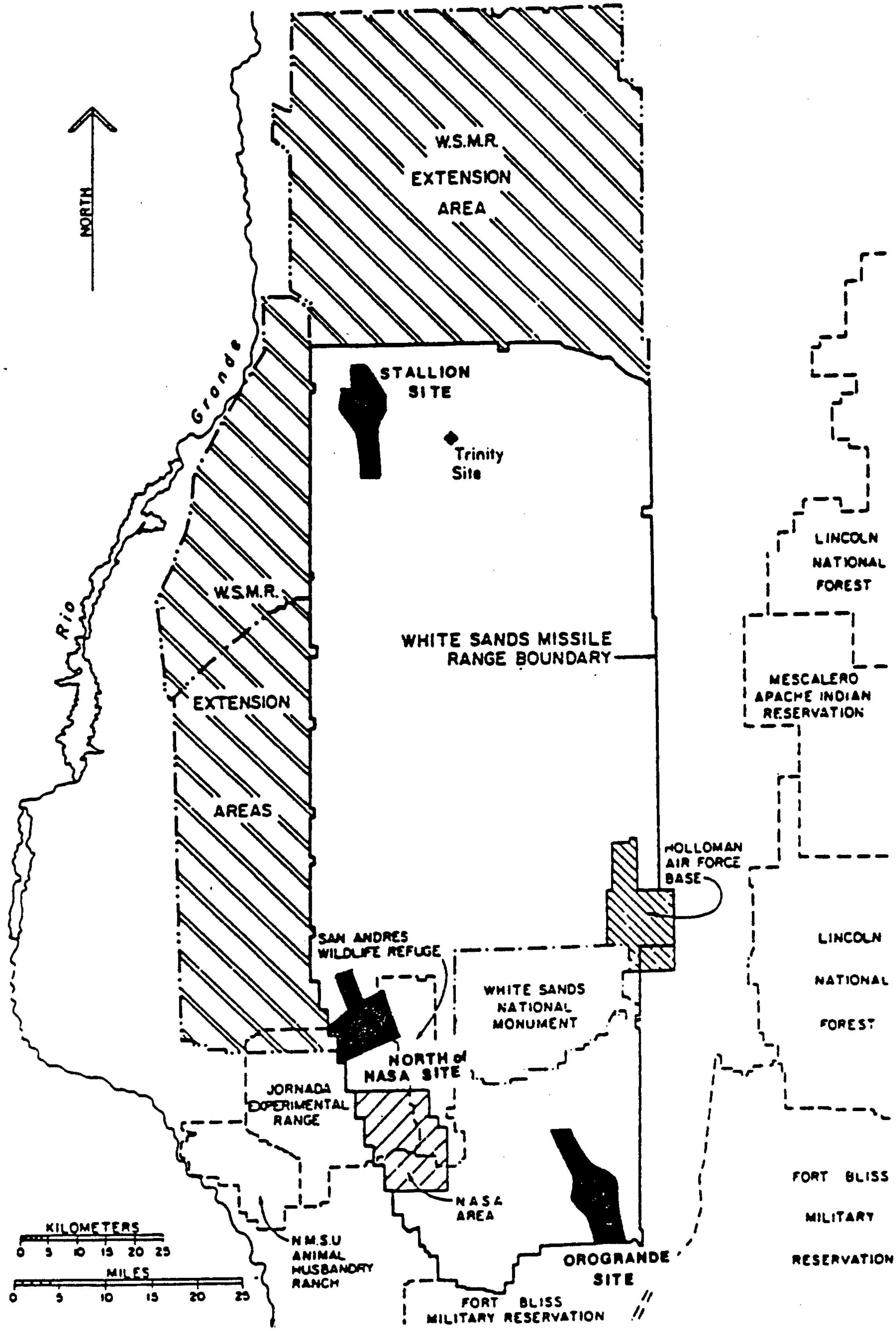

FIGURE 3-2 WSMR CANDIDATE SITES

gather and analyze data on the sites' various features and to determine any meaningful differences between the sites.

A method was developed to normalize the data from these diverse studies to a common base for comparison. The approach used explictly identified an underlying basis for evaluating or comparing all site-related factors. That basis was the degree to which accomplishment of the project mission was enhanced or impaired. The degree of mission accomplishment was itself determined by only a short list of dimensions:

- Achievement of technical/experimental objectives
- Project schedule
- Project cost
- Achievement of legal/regulatory objectives
- Degree of conflict with other programs.

The SSC required that the results of each of the listed studies be presented in terms of one or more of these dimensions. For instance, "poor" accessibility of a site was expressed in terms of the cost and/or the schedule delay that would be required to provide adequate roads to the site. Thus, the method shown in Figure 3-3 provided the means by which results from a long list of diverse studies could be readily compared.

These study results, which are presented in Section 3.3, were then aggregated by the SSC. The 18 site selection topics (subfactors) were grouped into the four site selection factors of Environmental Impact, Construction Engineering, Experimental Issues, and Range Conflicts. Furthermore, the SSC was able to consolidate the dimensions to those shown in Table 1-3; cost increase, delay or test time lost, and unavoidable impacts. This streamlined presentation of site study results allowed the SSC, and ultimately the decision-maker, to focus on a clear set of distinctions among the sites.

18 SITE VALIDATION STUDIES:

- ENVIRONMENTAL IMPACT STATEMENT
- TOPOGRAPHIC SURVEYS
- CONSTRUCTION RESOURCES ANALYSIS
- ELECTRIC POWER STUDIES
- COST ESTIMATES
- WATER SUPPLY STUDY
- SAFETY STUDIES
- EMI & EMC STUDIES
- ATMOSPHERIC MEASUREMENTS
- SECURITY STUDIES
- HAZARDOUS WASTE STUDIES
- EXPERIMENTAL ISSUES
- PROGRAM CONFLICTS
- WSMR BASE FACILITY SUPPORT
- COMMUNICATIONS
- FACILITY RISK ANALYSIS
- UTILITIES AVAILABILITY STUDY
- GEOTECHNICAL AND SEISMIC STUDIES

ALL RESULTS REPORTED IN TERMS OF:

- ACHIEVEMENT OF TECHNICAL/ EXPERIMENTAL OBJECTIVES
- COST
- SCHEDULE
- ACHIEVEMENT OF LEGAL/ REGULATORY OBJECTIVES
- MISSION CONFLICTS

THESE DIMENSIONS DETERMINE:

DEGREE OF MISSION ACCOMPLISHMENT

FIGURE 3-3 REDUCTION TO A COMMON MEASURE

3.3 SUMMARY OF DATA PRESENTED

The 18 topics pertinent to the site selection process are shown on Figure 3-1.

3.3.1 Cost/Schedule

A brief presentation of the GBFEL-TIE cost and schedule factors was given to the committee to acquaint them with the overall construction program before the task of site evaluation. A quick review was made of the DD Form 1391 cost estimate of the project to provide an understanding of the scope of the work planned. As presently planned, GBFEL-TIE will be a two-phase project: Phase I - Moderate Power Experiments; and, depending on the outcome of Phase I, Phase II - High Power Experiments. The overall facility construction cost of the Phase I program was estimated to be approximately $230M. The tentative schedule presented for Phase I called for site development work to begin by mid-1987 with completion of facility construction and technical equipment installation by late 1990. Phase II, when approved for construction, would require four additional years for facility design, construction, and installation of technical equipment.

3.3.2 Atmospheric Issues

The purpose of the atmospheric studies was to determine if the atmosphere at any of the three candidate sites was significantly different in the terms of particulates, turbulence, winds, or general meteorology. Each of these elements have the potential to adversely affect the propagation of the laser beam. Detailed atmospheric measurements were taken at different times at each of the three proposed sites. During each of these collection periods, data was also collected simultaneously at the High Energy Laser Instrumentation Development Laboratory (HIDL) site, a site for which a relatively large atmospheric data base exists. All measurements at the candidate sites were then scaled to this HIDL data base. Scaling the data to the HIDL data base helped in analyzing temporal fluctuations in atmospheric conditions between the three sites. Atmospheric evaluation elements are shown in Table 3-1. No major differences in cost, schedule, or ability to achieve experimental objectives were found among the three sites. This

ATMOSPHERIC MEASUREMENTS

DETAILED MEASUREMENTS WERE TAKEN OF THE FOLLOWING PARAMETERS:

- **PARTICULATES**
  - Mass Loading
  - Turbidity
- **TURBULENCE**
  - Coherence Length (at 8M)
  - Isoplanatic Angle
  - Optical Refractive Index Structure Parameter (at 8M)
- **WINDS**
  - Horizontal Winds (at 8M)
  - Maximum Winds Aloft
- **GENERAL**
  - Cloud Cover
  - Visibility

TABLE 3-1 ATMOSPHERIC MEASUREMENTS

result was not unexpected due to the sites' general similarity in weather, geography, and vegetation.

3.3.3 Safety Issues

Studies of safety issues included facility hazardous and system hazardous events along with system effects and risk assessments. One primary safety risk is laser refraction, which was addressed in its most sensitive aspect, eye safety. The eye safety study considered use of eye safety buffer zones, locations of ground and air targets, and reflections from those targets. For eye safety considerations, three different buffer zones were identified: a 1 Kilometer (Km) hazardous zone, a 3 Km controlled access zone, and a 3 Km aerial buffer zone. It was established that all sites have sufficient area for these safety zones.

For the ground target range location, all three candidate sites have adequate area. The initial orientation of the North of NASA site did not provide a sufficient line-of-sight between the GBFEL-TIE beam director and possible long range (10 Km) ground targets because several hills encroached on the desired sight path. A slight rearrangement of the orientation of the ground target range provided a solution. Reflections from test targets was determined a significant issue, but one able to be adequately handled by target design. This was, therefore, not a site selection determinant.

For radiation safety considerations, it was established that the electron beam dump must be above the water table. All sites have a ground water level at least 100 feet below the surface, thus, radiation safety will not adversely affect site selection. All other radiation safety considerations were determined manageable by design and are not site selection determinants. The conclusions of the safety studies were, therefore, that no major differences in cost, schedule, or objectives were found among the three sites.

3.3.4 Environmental Impact

Major environmental impact considerations included vegetation and wildlife; threatened, endangered and protected species; and cultural resources. As shown in Table 3-2, several other topics were studied but were not found to have a significant influence on the selection of a project site. Many of these subjects require statutory compliance and/or coordination and consultation with various federal and state agencies, requirements which were highlighted during the study process.

A summary of significant site differences in vegetation and wildlife, threatened and endangered species and cultural resources is shown in Table 3-3.

The site determined most favorable for location of the GBFEL-TIE, from an environmental aspect, was Orogrande. The site has sparse vegetation of relatively low value for wildlife habitat. Area cultural resources would be affected, but these impacts would be less significant than at North of NASA.

The North of NASA site was the least favorable in terms of environmental impact. Archaeological sites containing potentially significant cultural resources were numerous. Exploration of these finds prior to construction had the potential for a delay to start of construction of 3 to 6 months and added costs of $5M. An additional cost impact of $8.0M could be required to mitigate impacts on wildlife, including possible replacement of a refuge area for desert bighorn sheep. Total additional environmental impact costs at North of NASA could be $14M higher than at Orogrande. See Table 3-3.

At Stallion, adverse impacts would result from the potential loss of grassland with consequent impact on wildlife. Replanting/restoration and research of its effectiveness was estimated to cost $1.0M. Further investigation of potential impacts to threatened, endangered and protected species such as bald eagles, whooping cranes, and baird's sparrow could cost $100K, and 2 to 3 months for surveys. Total additional environmental impact cost of location at the Stallion site vs. Orogrande was estimated at $1.1M.

Socioeconomic elements including workforce distribution, community population changes, housing, police, schools, fire protection, traffic and transportation, and health care impacts on the communities potentially affected by each candidate site were studied. The potential

ENVIRONMENTAL IMPACT CONSIDERATIONS

*Vegetation and Wildlife
*Threatened and Endangered Species
 Air Quality
 Noise
 Water Resources
 Eye Safety
 Soil and Drainage
*Cultural Resources
 Socioeconomics
  Community Population Changes
  Housing
  Police, Schools, Fire
  Traffic and Transportation
  Health Care

* Significant Site Differences

TABLE 3-2 ENVIRONMENTAL IMPACT CONSIDERATIONS

MAJOR ENVIRONMENTAL IMPACT CONSIDERATIONS

	STALLION			NORTH OF NASA			OROGRANDE		
	COST INCREASE ($M)	DELAY (mo.)	UNAVOIDABLE IMPACTS	COST INCREASE ($M)	DELAY (mo.)	UNAVOIDABLE IMPACTS	COST INCREASE ($M)	DELAY (mo.)	UNAVOIDABLE IMPACTS
Vegetation and Wildlife	0.5 / 1.0		Loss of relatively valuable habitat	0.0 / 1.0		Loss of more valuable habitat than Orogrande	0.0 / 0.0		
Threatened, Endangered, and Protected Species	0.1 / 0.1	2 to 3	Risk to several species	8.0 / 8.0	3 to 6	Risk to several species; impacts on refuge	0.0 / 0.0		
Cultural Resources	0.0 / 0.0			5.0 / 5.0	3 to 6	More sign. loss; 500 extra, valuable acres	0.0 / 0.0		
Subtotals	0.6 / 1.1	2 to 3	Slightly greater wildlife and T&E risk	13.0 / 14.0	3 to 6	Greater wildlife, T&E & Arch. Impacts	0.0 / 0.0		

TABLE 3-3 MAJOR ENVIRONMENTAL IMPACT CONSIDERATIONS

environmental impacts are described in more detail in the environmental impact statement prepared for this project.

3.3.5 Water Supply

Estimated maximum water supply requirements of 1.44 million gallons per day were found to be available at any of the three sites. Water quality of 700 parts per million (PPM) or less of dissolved solids can be provided to all sites. Carbonate hardness was typically found to be a very small part of the total dissolved solids, so reverse osmosis treatment was not considered necessary to improve water quality at any site.

The water supply study identified several possible alternative sources for each site. The preferred alternative for the North of NASA site offered the lowest water supply cost. The source would be supply wells drilled in the Jornada Range on federal lands (U. S. Department of Agriculture). Water distribution would be through 12 miles of pipeline with one booster station. Additional effort would be required to secure state water permits and to prepare environmental analyses but these efforts would not be expected to delay the construction schedule.

The preferred Orogrande alternative would be supply from wells in the Soledad Canyon Area (Ft. Bliss). Twenty miles of pipeline and a booster station would be required. Water quality was found higher than at the other two potential sites with dissolved solids less than 300 PPM. WSMR has previously filed a declaration of water rights in this aquifer with the New Mexico State Engineer. Environmental analysis would be required. Construction water is available at Orogrande via an 8" line from WSMR Post Headquarters. The other two sites would require tanker water or wells to meet early construction requirements.

Stallion site could be supplied with wells drilled into the Rio Grande River Valley alluvium near, but not on, a federally owned wildlife refuge. Twenty-two miles of pipeline and a booster station would be required. It would be necessary to obtain right of way (ROW) across private property as well as state water permits. Additional environmental analysis would also be required.

Water supply at Orogrande or Stallion would require an additional cost of approximately $800K compared to that at North of NASA. See Tables 3-4 and 3-5.

3.3.6 Other Utilities Availability

A study was also made of the availability of utilities other than water and electricity. Utility service considered included fuel oil, natural gas and sanitary waste. Fuel oil delivery to the site would be made by tanker, and study results indicated no substantial cost differences among sites. Sanitary waste would be site treated and discharged and was determined not to be a site selection determinant.

Initially, site differences were found in the construction of natural gas pipelines. The cost differences were primarily due to the length of pipeline required to tie into existing high pressure gas lines. Further evaluation of Phase I requirements requested by the SSC, however, revealed that pipeline extension would not be cost effective in comparison with other energy sources. For Phase II, natural gas fuel delivery would only be justified if on-site gas turbine electrical generation were utilized. Pipeline costs were not included because, although the Phase II power concept is still under development, energy storage is currently the preferred approach. There were no cost differences between the sites for other utilities.

3.3.7 WSMR Base Facility Support

The GBFEL-TIE has four potential types of requirements for WSMR target support: ground targets at 1-9 Km range, airborne target arrays at 40-50K ft, high altitude target arrays at 200-300K ft, and satellite targets. WSMR test support can include the following: surveillance radars, roadblocks, drone presentations, high altitude rocket launches, missile flight safety, test support planning, instrumentation radars, telemetry, satran reports, and radar data reports. The study of base facility support concluded that the required support could be provided at any of the three candidate sites with equivalent efficiency and cost. Thus, there were no differences between cost, schedule and objectives among the three candidate sites.

WATER SUPPLY

(No differences between Phase I & Total Project)

- Stallion

  22 miles of pipeline to preferred source in wildlife refuge (Rio Grande alluvium)

- North of NASA (baseline cost)

  12 miles of pipeline to preferred source in Jornada Test Range

- Orogrande

  20 miles of pipeline to preferred source in Soledad Canyon

TABLE 3-4 WATER SUPPLY

WATER SUPPLY

	STALLION		NORTH OF NASA		OROGRANDE	
	UNITS	COST ($M)	UNITS	COST ($M)	UNITS	COST ($M)
Supply Wells	4	1.245	2	1.443	3	1.995
Test Wells	2	0.025	4	0.104	2	0.042
Pipeline	22 mi.	2.992	12 mi.	1.632	20 mi.	2.720
Pump Stations	1	0.248	1	0.245	1	0.124
Electric Service		0.634		1.056		0.264
Subtotal Contingency S&I (5.5%)		5.114 0.772 0.283		4.483 0.672 0.247		5.145 0.772 0.283
Total		6.2		5.4		6.2

TABLE 3-5 WATER SUPPLY SUMMARY

The facility support study also included support categories such as housing, fire protection, security and transportation. Given the anticipated magnitude of the project and its infrastructure, heavy reliance on WSMR proper for such support was not expected. Attempts to cost this support did not result in any significant differences among sites.

3.3.8 Experimental Issues

Experimental issues studies were conducted to determine the capabilities of the sites to meet the needs of the operational GBFEL-TIE. Considerations were general location criteria, availability of controllable areas for ground safety zones, and the amount of controllable airspace available at each site. The location criteria include a clear line of sight to 75° from vertical for target acquisition in the direction of possible target presentations. Ground safety zones for distances of 3 km from beam path were determined to be controllable at all sites. The amount of controllable airspace each site offered was defined as the percentage of a 360° arc 45° from vertical which did not extend into airspace out of the WSMR airspace boundaries. Orogrande would have 60% of the 360° arc useable within the WSMR airspace. North of NASA would have 80% of the arc useable, and Stallion would have 90% of the arc useable. The SSC determined that, based on anticipated target presentations, all three sites had sufficient controllable airspace for beam propagation. Therefore, there were no significant differences between the three sites for this subfactor.

3.3.9 Program Conflicts

Program conflicts with other existing and proposed WSMR programs could be expected at any of the three candidate sites. The program conflict study considered potential requirements for facility relocations and to what extent evacuations of the GBFEL-TIE site might be necessary, as well as the compatibility of GBFEL-TIE with existing or proposed future test programs.

Locating the GBFEL-TIE at the North of NASA site would have some impact on the air-to-air combat training done by the Tactical Air

Command at the nearby YONDER training area due to increased airspace restrictions. Use of this site could also conflict with the U.S. Navy Vandal Missile Program and the NASA High Altitude Sounding Rocket Program, although such impacts would not likely be serious.

At Stallion site there currently are seven projects which would be impacted by the GBFEL-TIE. U.S. Air Force use of the Air Combat Maneuvering Instrumentation (ACMI) equipment included 253 operations involving 8604 sorties and 1968 hours of range time on WSMR in 1986. If Stallion were selected, ACMI operations would lose approximately 10% of their range time and approximately 20% of the WSMR areas used. Long range trajectories for missile systems fired from Green River, Utah, and Mountain Home, Idaho, launch sites overfly the Stallion area. Although not currently in use, these trajectories are a unique WSMR asset. The Permanent High Explosive Test Site (PHETS) is located 9 miles from Stallion. A 6000 ton (6 KT) blast at PHETS would cause overpressures of 0.06 pounds per square inch (psi) and a ground motion of approximately 0.01g at Stallion. (0.01g is the approximate threshold for disruption of GBFEL-TIE alignment and/or testing.) A Warheads Impact Target (WIT) area near Stallion is utilized approximately 10 times a year for Multiple Launch Rocket System (MLRS), LANCE and Army TACMS tests. A new SDI Program, EXCEDE III, proposes overflights of the Stallion area. This site is also in the dispersion pattern for NIKE-Orion tests using a northwest aimpoint. Periodic military exercises involving the use of ground-based air-defense units, low-flying supersonic aircraft and nighttime aircraft landings at Stallion would probably have to be conducted elsewhere.

Orogrande is expected to be affected by Pershing missile overflights just west of the site, and by military exercises. Although the Pershing missile overflights are expected to have no direct impact, there is reduced reaction time for flight safety personnel and the potential for premature destruction of a missile should it appear to stray toward the GBFEL-TIE site. This site affects the Borderstar exercise training area where up to 6,000 troops with armored vehicles participate every two years. Training exercises would be precluded or limited in 25% of the Borderstar exercise area. The GBFEL-TIE could be impacted by any nearby Borderstar exercise due to the exercise dust and air pollution.

These potential range conflicts are summarized in Table 3-6. The significance of the Stallion impacts was determined to be much greater than those at either North of NASA or Orogrande.

Program conflicts were also expressed in terms of GBFEL-TIE site evacuations caused by other WSMR test programs. These events were estimated to occur in one-half day increments, based on data obtained from WSMR. All tests in the site vicinity would not result in an interference or roadblock. Approximately one-half of all scheduled interferences could be worked around so as not to cause any GBFEL-TIE impact. When such impacts did occur, either construction cost or schedule would be affected. The schedule could be maintained by using more costly overtime construction, or the schedule could slip. See Table 3-7 and Table 3-8. For site selection comparison, the SSC, considering the priority of the GBFEL-TIE and its fast-track schedule to date, utilized estimates from Table 3-7 for use of overtime construction to maintain schedule. This resulted in large cost penalties for both Stallion and Orogrande.

The potential need to relocate existing WSMR facilities as a result of siting the GBFEL-TIE nearby was also studied. The result of this analysis, and companion analyses in the areas of RFI/EMI interference and eye safety, was a determination that the only required relocations would be that of a Chapparal target tower at Orogrande, estimated to cost $100K, and a relocation of "Green Site" instrumentation at the Stallion site, estimated at $200K. See Table 3-9.

3.3.10 Geotechnical and Seismic

A seismic study was conducted to determine the vulnerability of each of the candidate sites to seismic activity and to estimate the time delays to the GBFEL-TIE project test program caused by seismic events for each of the three sites. The study considered three possible conditions: Microseismicity, strong ground motion, and maximum credible

MAJOR RANGE CONFLICT CONSIDERATIONS

	STALLION	NORTH OF NASA	OROGRANDE
	PROGRAM IMPACTED	PROGRAM IMPACTED	PROGRAM IMPACTED
WSMR (and Range User) Impacts	ACMI Green River/Mt. Home Trajectories PHETS Stallion WIT Excede Navy/NASA High-Altitude Tests Military Exercises	Yonder Area Training Navy/NASA High-Altitude Tests	PERSHING (Test Risk) Military Exercises

TABLE 3-6 MAJOR RANGE CONFLICT CONSIDERATIONS

CONSTRUCTION INTERFERENCE DUE TO EVACUATIONS AND ROADBLOCKS

OVERTIME MAKE-UP TO MAINTAIN SCHEDULE

	STALLION	NORTH OF NASA	OROGRANDE
• Interferences (Days/Month)	2.5	0	2
• Workaround (50%)	1.25	0	1
• Impacts			
Schedule day/mo.	1.25	0	1
Cost/Month to recovery	$0.375M	0	$0.3M
• Construction Recovery			
Cost/Year	$4.5M	0	$3.6M
Phase I**	$9.0M	0	$7.2M
Total Project*	$27.0M	0	$21.6M

*Based on WSMR historical data.

**Assumptions: Phase I requires recovery for 2 yr
Total project requires recovery for 6 yr

TABLE 3-7 CONSTRUCTION INTERFERENCE

CONSTRUCTION INTERFERENCE
DUE TO EVACUATIONS AND ROADBLOCKS

STRAIGHT TIME MAKE-UP WITH SCHEDULE IMPACT

	STALLION	NORTH OF NASA	OROGRANDE
• Interferences (Days/Month)	2.5	0	2
• Workaround (50%)	1.25	0	1
• Impacts			
Schedule day/mo.	1.25	0	1
Cost/Month	$0.20M	0	$0.16M
• Construction Make-Up			
Cost/Year	$2.4M	0	$1.9M
Phase I**	$4.8M	0	$3.8M
Total Project*	$14.4M	0	$11.5M

*Based on WSMR historical data.

**Assumptions: Phase I requires recovery for 2 yr
Total project requires recovery for 6 yr

Schedule Impact Remains

TABLE 3-8 CONSTRUCTION INTERFERENCE

FACILITY RELOCATIONS

STALLION	NORTH OF NASA	OROGRANDE
• Green Site (radar and camera) - On proposed GBL site - WSMR Instrumentation Facility Estimated Cost: Radar Facility $100K Camera Facility $100K Total $200K	• None	• Chaparral Target Tower - Must move to support scenario rotation - Used for Chaparral and Stinger tests - Estimated cost: $100K

TABLE 3-9 FACILITY RELOCATIONS

earthquake. The maximum credible earthquake was determined to be a factor of interest for facility design, but one which would be handled similarily at any of the sites. On the other hand, microseismicity and strong ground motions were factors in site selection since they can directly affect test operations.

Microseismicity includes all earthquakes up to the threshold of damage, which is estimated as a ground acceleration of 0.01g, capable of causing equipment misalignment or test delays. (This threshold is roughly equivalent to a magnitude 2.7 earthquake at near field distance.) Based on data from local area instrumentation in place since 1960, about 50 events of this magnitude or greater are likely to occur over a 25-year facility life at any of the three sites. The expected result is interference with project activities less than 1% of the time.

The Socorro area, however, has a record of more severe seismic activity. Based on historical records dating from 1849, Socorro has experienced seismic swarms of about 12 weeks duration on an average of about every 25 years. Additionally, such swarms of earthquakes have included strong ground motion events, with up to three magnitude 6 events documented during a 1906 swarm. Such strong earthquakes may require additional delays beyond the duration of the event itself to allow for time to survey for and correct misalignment or to check and recalibrate critical equipment. Addition of realignment and recalibration time to an expected 12-week swarm over a 25-year period results in an estimated 8% average loss of test time for the Stallion site. Additionally, since earthquake swarms occur episodically, not spread evenly over the 25-year interval, Stallion has the possibility that any seismic event would affect months of operational time. The conclusion was that Stallion was several times more likely to experience seismic activity detrimental to test operations than were the North of NASA or Orogrande sites. See Table 3-10 and Table 3-11.

3.3.11 Electrical Power

Studies established that drawing power for the laser tests directly from the existing commercial power grid was technically

SEISMIC DISTURBANCE

- Major earthquake effects -- construction/engineering consideration site independent
- Seismic effects on test operations -- site dependent
  - Common seismicity (all three sites) from recent instrumentation
    - -- Instrumentation from 1960 to present
    - -- Indicates an average loss of test time of $<1\%$
  - Socorro area seismicity (Stallion site)
    - -- Historical data from 1849 to present
    - -- Cyclic earthquake swarms

      Average duration 12 weeks
      Average reoccurrence every 25 years
      Swarms may contain strong motion events
      Could cause an average loss of test time of 8%
      Last swarm recorded in 1935
      A swarm could cause a loss of test time of up to 40%
    - -- Magma dome forming

      The probable cause of swarms
      Causing an average ground rise of 5 mm per year at Socorro
      Dome is still being formed

TABLE 3-10 SEISMIC DISTURBANCE

MAJOR EXPERIMENTAL CONSIDERATIONS

	STALLION			NORTH OF NASA			OROGRANDE		
	COST INCREASE ($M)	LOST TEST DAYS	REMARKS	COST INCREASE ($M)	LOST TEST DAYS	REMARKS	COST INCREASE ($M)	LOST TEST DAYS	REMARKS
SEISMIC DISTURBANCES		8%	POSSIBILITY OF EARTHQUAKE SWARMS AFFECTING MONTHS OF OPERATIONAL TIME						

TABLE 3-11 MAJOR EXPERIMENTAL CONSIDERATIONS

feasible for Phase I experiments. The estimated cost for providing a connection to the existing power grid was site dependent, and was a function of length and type of power transmission line, static VAR compensation to ensure electrical matching to the grid, and any right of way required. Table 3-12 shows estimated costs for this Phase I grid connection. The cost of the electrical power connection was higher at North of NASA by $2.4M and at Stallion by $4.9M than at Orogrande.

At the power levels anticipated for Phase II, total electrical power from the grid may not be feasible. Although the power concepts for Phase II are still being examined, viable options include power generation on-site and energy storage on-site rechargeable by either the grid or on-site generators. For completeness, Table 3-13 is included showing estimated costs if the power grid was used to supply Phase II requirements. Table 3-14 shows estimates of cost differences among sites for complete power generation on-site and for rechargeable energy storage on-site.

After examination of all electrical power study data the SSC decided to use the option of energy storage with grid recharge as the basis for Phase II site comparisons. This resulted in no additional cost differences beyond Phase I differences identified above.

3.3.12 Topographic

Topographic surveys provided information on three items: providing all-weather highway access to serve the sites; constructing facilities to lay lightly on the terrain to minimize excavation and embankment quantities; and installing site drainage structures necessary to prevent excessive scour and ponding. On-site roads would be the same for each of the three sites. Off-site access roads were located to provide the most direct connection to existing highways. Stallion site would require 1.5 miles of new road construction at an estimated cost of $0.45M. Orogrande would require 2 miles of new construction costing $0.60M. North of NASA would require 17 miles of new construction costing $6.46 plus 5 miles of reconstruction at $0.90M. See Table 3-15 and Table 3-16.

ELECTRIC POWER

PHASE I	STALLION		NORTH OF NASA		OROGRANDE	
	UNITS	COST ($M)	UNITS	COST ($M)	UNITS	COST ($M)
Transmission Line (345 kV)						
Single Circuit ($170K/mile)					10 mi.	1.70
Double Circuit ($275K/mile)	30 mi.	8.25	20 mi.	5.50		
Static VAR Compensation ($13k/MVAR)	518 MVAR	6.73	540 MVAR	7.02	660 MVAR	8.58
Right of Way ($10K/mile)	18 mi.	0.18	15 mi.	0.15		No ROW
Subtotal		15.2		12.7		10.3

TABLE 3-12 PHASE I ELECTRIC POWER

ELECTRIC POWER

PHASE II FROM GRID

PHASE II (ADDITIONS)	STALLION		NORTH OF NASA		OROGRANDE	
	UNITS	COST ($M)	UNITS	COST ($M)	UNITS	COST ($M)
• Transmission Line Double Circuit ($250K/mi)					60 mi	15.000
• Static VAR - Compensation - ($13K/MVAR)	290 MVAR	3.770	360 MVAR	4.680	900 MVAR	11.700
• Other Modifications		1.000		1.000		
Subtotal		4.770		5.680		26.700
Total Project		20.0		18.4		37.0

TABLE 3-13 ELECTRIC POWER

ELECTRIC POWER PHASE II ON-SITE

- Assumes Phase I power from grid is present (Base Load).
- Power generation (1,000 MW Pulse) - Gas turbine

	GAS TURBINE CAPITAL COST	FUEL DELIVERY SYS. CAPITAL COST	OPERATING COST	DELTA COST*
Orogrande	$600M	$16M	$10M/yr	$ 0
North of NASA	$600M	$20M	$10M/yr	$ 4M
Stallion	$600M	$52M	$10M/yr	$36M

- Energy storage - super conducting inductor

	DESIGN FABRICATION INSTALL CAPITAL COST	RECHARGE FROM GRID DELTA COST**	RECHARGE ON-SITE CAPITAL COST	ON-SITE OPERATING COST	RECHARGE ON-SITE DELTA COST
Orogrande	$175M	$0	$50M	$0.1M/yr	$ 0
North of NASA	$175M	$0	$60M	$0.1M/yr	$10M
Stallion	$175M	$0	$80M	$0.1M/yr	$30M

*Cost delta is because of fuel delivery system (off-site pipeline)

**Capital cost of Phase II is the same for Phase I for on-site grid power

TABLE 3-14 ELECTRIC POWER PHASE II ON-SITE

ACCESS ROAD

(No differences between Phase I & Total Project)

- Stallion (baseline cost)
  1.5 mi. of new road from Highway 5

- North of NASA
  5 mi. of road reconstruction from Highway 70 to NASA
  17 mi. of new road from NASA

- Orogrande
  2 mi. of new road from Nike Avenue

TABLE 3-15 ACCESS ROAD

ACCESS ROAD

HIGHWAY ACCESS DESCRIPTION	STALLION	NORTH OF NASA	OROGRANDE
New Construction Length (mi.)	1.5	17	2
New Construction Unit Cost ($K)	$300/mi.	$380/mi.**	$300K/mi.
New Construction Subtotal ($M)	$0.45	$6.46	$0.60
Reconstruction Length (mi.)	0	5	0
Reconstruction Unit Cost ($K)	$0	$180/mi.	$0
Reconstruction Subtotal ($M)	$0	$0.90	$0
Highway Access Total Cost ($M)	$0.45	$7.36	$0.60
Highway Access Delta Cost ($M)	$0	$6.91	$0.15

**Higher unit cost due to more drainage crossings than at other sites.

TABLE 3-16 ACCESS ROAD COSTS

Existing terrain at North of NASA has a uniform ground slope along the facility centerline of less than 2%. The other sites have terrain with slopes of less than 1%. Some additional drainage structures would be required at the Orogrande site as compared to the other sites. Neither the terrain nor the drainage factors, however, resulted in significant cost or schedule differences. Hence, the topography-related site differences were cost differences, due to access roads, of $0.2M at Orogrande and $6.9M at North of NASA as compared to the Stallion site.

3.3.13 Construction Resources Analysis

The Construction Resources Study identified the major material resources necessary for GBFEL-TIE construction. Sand, aggregate, and asphalt were found to be available in the vicinity of each of the three sites. Manufactured materials such as siding, roofing, steel, cement, masonry block, and precast/prestressed concrete would have to be shipped to the sites from manufacturers. Concrete supplies are located in four major cities near WSMR: El Paso, Alamogordo, Las Cruces, and Albuquerque. Differences in costs for these materials, including transportation to site, were not found to be a significant factor for site selection.

3.3.14 Physical Security

Physical security for the GBFEL-TIE would essentially be the same for all three sites. At Stallion it would be somewhat easier to prevent intrusion by personnel on foot and in individual vehicles. The dunes and the relative proximity to the U.S./Mexico Border of the two southern sites, as well as the archaeological attractions at North of NASA, were negative aspects of physical security at these two sites.

Adequate physical security at either North of NASA or Orogrande could be accomplished with additional security patrols (guards) as an alternative to additional surveillance hardware. Increased guard patrols at a small annual cost would equalize the effective physical security of the sites. Hence, physical security was not a significant factor for site selection.

3.3.15 Hazardous Waste

A study was made of the potential for generating hazardous waste at the GBFEL-TIE site. The objective was to identify the composition and estimate the quantity of hazardous, toxic, or radioactive by-products or residues generated by the project. Hazardous waste storage and handling are regulated by both federal and New Mexico codes. It was determined that most radioactive waste to be generated and removed would be low level waste from cooling water resins and filters, decontamination filters and disposable clothing, paper and rags. Primary volumes of toxic substances would be motor oils, cleaning solvents, sludges from water treatment, etc. Volumes of hazardous waste to be removed from the site would be less than one truckload per year; however, due to permitting requirements for storage, hazardous waste products would be removed more frequently. A review was made, by site, of the postulated controlled substances. No site specific differences were determined relative to the disposal of radioactive or toxic compositions.

3.3.16 RFI/TEMPEST

Two separate studies were conducted on the issue of radio frequency interference (RFI) and TEMPEST considerations. Unshielded, GBFEL-TIE components have the potential to emit a large amount of broadband interference which would adversely impact other technical facilities both on WSMR and in the surrounding WSMR area. The purpose of the studies was to determine how sensitive neighboring facilities are to the type of RFI the GBFEL-TIE could emit, and to examine the degree to which the GBFEL-TIE facilities could be shielded to prevent such interference.

Several neighboring facilities were investigated including the National Radio Astronomical Observatory Very Large Array (VLA) facility near Socorro, NM, the NASA Telemetry Data Relay Satellite System (TDRSS) near the North of NASA site, and the Vulnerability Assessment Laboratory (VAL) near the Orogrande site. The study conclusions were that, if adequate attention is given to shielding during design and construction, RFI will not be a problem at any of the sites. Additionally, no significant cost or schedule differences were expected among the sites for either RFI shielding or TEMPEST considerations.

3.3.17 Communications

Fiber optics are expected to be used for the communication system. WSMR is in the process of installing a fiber optic trunk within close proximity of all three candidate sites. At the Orogrande site, fiber optics lines would be within six miles, and a tie-in for construction communications would be available. At Stallion, fiber optics communications lines would be within three miles, and again, construction communications would be available. At the North of NASA site, no communication lines presently exist; however, fiber optics lines would be within 12 miles. Radios may be required at this site during early construction.

As shown in Table 3-17, installation costs did not differ among sites. (The North of NASA tie would follow established roads/utility corridors.) Therefore, the cost differences are \$0.3M for Orogrande and \$0.9M for North of NASA as compared to the Stallion site.

3.3.18 Facilities Risk

Facilities risk analyses considered the risk to the GBFEL-TIE site and facilities posed by projectiles impacting at WSMR. All WSMR test scenarios were examined and scenarios modified as would be appropriate for each site given a final selection of that site for the GBFEL-TIE. The results of the worst case site risk analysis are the product of the residual risk level (probability that at least one piece of debris will land within the GBFEL-TIE site boundary annually) for the individual sites and the probability (1.49×10^{-4}) of impacting a 30 meter by 30 meter area near the center of the GBFEL-TIE site. Statistically, the North of NASA site would have the least risk (1.9×10^{-7}). The estimates for Orogrande and Stallion sites were not significantly different (2.7×10^{-7}) and (3×10^{-7}). Hence, the SSC did not further consider this factor in site selection. (Results of these analyses pertaining to scenario modifications/facility relocations were considered under Program Conflicts.)

COMMUNICATIONS

(No differences between Phase I & Total Project)

- Stallion (baseline cost)
  3 mi. to WSMR fiber optics system
  Vicinity of Stallion communications center

- North of NASA
  12 mi. to WSMR fiber optics system
  Vicinity of Range Road 7

- Orogrande
  6 mi. to WSMR fiber optics system
  Vicinity of Nike Avenue

(COST OF INSTALLATION $100K/mi.)

TABLE 3-17 COMMUNICATIONS

3.3.19 Other Studies

The original 18 studies were augmented, as the need arose, by additional study efforts in certain areas. Previous sections have included discussion of additional efforts requested by the SSC in the areas of RFI and facility risk, for example. One additional study not previously addressed is the Light Pollution Study, requested by the SSC as a result of public comments on the draft EIS. Its purpose was to estimate GBFEL-TIE lighting requirements and analyze the impact of scattered light from the site on present and proposed astronomical observatory sites in the WSMR vicinity. The study concluded that the proposed lighting would not be expected to threaten optical astronomy at any of the three sites. Significant input was provided to GBFEL-TIE designers, however, concerning the project's exterior lighting design.

4.0 CONCLUSION

The USASDC has conducted a thorough, systematic siting analysis process in order to identify the most suitable site for the GBFEL-TIE. The essential elements of this process have been documented in the series of site selection reports and in the EIS. The site recommendation made by USASDC represented consideration of the best available information on all factors known to be relevant to this decision.

APPENDIX A

GROUND BASED FREE ELECTRON LASER
TECHNOLOGY INTEGRATION EXPERIMENT
RECORD OF DECISION

GROUND BASED FREE ELECTRON LASER TECHNOLOGY INTEGRATION EXPERIMENT RECORD OF DECISION

Pursuant to Council on Environmental Quality regulations implementing the National Environmental Policy Act, this document records the siting decision for the Strategic Defense Initiative Organization's Ground Based Free Electron Laser Technology Integration Experiment (GBFEL-TIE) which is to be executed by the U. S. Army Strategic Defense Command (USASDC) at the U. S. Army White Sands Missile Range (WSMR), New Mexico. The location known as Orogrande is the selected site.

Fourteen areas within the boundaries of WSMR were initially identified as potential locations for the laser facility and were evaluated based on numerous criteria including site-area requirements and proximity to gypsum deposits. These fourteen areas were narrowed down to three alternative sites which were then evaluated in detail as to their suitability for the GBFEL-TIE. These evaluations were conducted in accordance with the spirit and intent of the National Environmental Policy Act and are documented in the environmental impact statement (EIS) for the project and in additional technical studies. The three sites -- Orogrande, near Orogrande, NM; North of NASA, near Las Cruces, NM; and Stallion, near Socorro, NM -- were compared on the basis of environmental impacts, construction and operation costs and schedules, and conflicts with other WSMR programs.

Orogrande is the environmentally preferred alternative. Siting at the North of NASA site would result in significant adverse impacts to extensive cultural resources, and significant adverse impacts to the state-protected desert bighorn sheep would be expected. At Stallion, cultural resources would be impacted, and relatively valuable grassland habitat would be lost, entailing adverse impacts on pronghorn antelope and other wildlife. At Orogrande, cultural resources would also be adversely affected, but not as extensively as at the North of NASA site. In addition, wildlife impacts at Orogrande would be less than at either Stallion or North of NASA.

Although the Orogrande site was determined to be the least expensive, estimated total costs for construction and operation of the GBFEL-TIE, including environmental mitigation costs, differ only slightly among the three sites.

The anticipated construction schedule favors the Orogrande site. Mitigation of environmental impacts would require initial delays of 3 to 6 months more at North of NASA, or 2 to 3 months more at Stallion than at Orogrande.

The gathering of experimental data at the GBFEL-TIE could be delayed by low-level seismic activity interfering with the precise alignment of the optical equipment. Of the three sites, Stallion has the greatest potential for such seismic interference. North of NASA and Orogrande pose less risk of such interference.

Some program and schedule conflicts with existing and future WSMR programs would occur at any of the three sites. However, substantially greater impacts would occur at the Stallion site. These conflicts would affect all three military services, and in the opinion of WSMR officials, would severly limit future operational capabilities of the national range. Thus Stallion is significantly inferior to the other two sites in this regard.

USASDC will carry out an appropriately tailored program of impact mitigation and monitoring at the Orogrande site, especially in regard to cultural and wildlife resources. An existing memorandum of agreement (MOA) between WSMR and the New Mexico State Historic Preservation Officer governs activities at WSMR. In accordance with the provisions of this memorandum, the USASDC will complete a detailed cultural resources survey, and will develop and conduct a detailed mitigation program in cooperation with the State Historic Preservation Officer. An MOA guiding the development and execution of a wildlife impact mitigation and monitoring program is being completed with the U. S. Fish and Wildlife Service, the New Mexico Department of Game and Fish, and the New Mexico Department of Natural Resources. This program will include appropriate mitigation measures and habitat restoration where feasible, as well as monitoring efforts to ascertain the actual effects of the project on wildlife resources. The mitigation measures will be modified as warranted by the monitoring results. Additional mitigation measures are detailed in Chapter V, Mitigation Measures, of the Final Environmental Impact Statement. These measures constitute all practicable means to avoid or minimize environmental harm.

A thorough public involvement process has been conducted throughout the site evaluation process. Public concerns, such as operation of the experiment, and socioeconomic and environmental effects, have all been carefully considered.

My decision has been carefully made in consideration of environmental impacts and other essential considerations detailed above. The goals of national defense, including the goals of the Strategic Defense Initiative, fiscal responsibility, and environmental protection are all best served by selection of the Orogrande site for the GBFEL-TIE.

3 March 1987
Date

James A. Abrahamson

James Abrahamson, USAF
Lieutenant General
Director SDIO